

Epic Management Inc.
Sent by email only to: ben@thinkepic.ca

May 1, 2023
Project #23-585

Attn: Ben Schweitzer

**Re: Flood Hazard Assessment Report for Single Family Residence Addition
Located at 405 Treebank Road East, Esquimalt, BC**

1.0 INTRODUCTION

The purpose of this report is to present the findings of our flood hazard assessment (FHA) for the proposed renovation and second story residence addition at 405 Treebank Road East in Esquimalt, BC. The project involves a renovation of the main floor within the existing footprint and a second-floor addition to a single-family dwelling on the north side of Treebank Road East, adjacent to the Gorge Waters in Esquimalt, BC. The property is potentially at risk of coastal flood hazards from the Victoria Harbour. The aim of this assessment is to identify and evaluate the flood hazards that may affect the safe development and use of the property with respect to the proposed development to an acceptable safety threshold, either without or with mitigation.

This report has been prepared by Coast Geotechnical and is structured as follows: a site and project description, followed by the pertinent guidelines and references, a coastal flood hazard assessment, and concluding with findings and recommendations. This report has been prepared for the exclusive use of Epic Management Inc. and their designated agents.

2.0 SITE & PROJECT DESCRIPTION

The proposed development is located in Esquimalt, BC, northwest of the Victoria Harbour and the property is directly adjacent to the Gorge Waters which outlet to Victoria Harbour. The Gorge Waters experience the same tidal systems as the Victoria Harbour. The property is surrounded by residences to the northwest and southeast with Treebank Road East to the southwest, and the Gorge Waters to the northeast. The elevation within the property ranges from 0 to 10.00 m, generally sloping down from southwest to northeast per *CRD Regional Map Contours*. The property is currently occupied by an existing single-family residence which is situated 8.15 m from the waterway.

In preparing this report we have been provided *Design Plans by Epic Project Management dated November 8, 2022*. Based on the *Plans*, we understand the renovation proposes to reduce the main floor footprint of the house with the addition being to the second floor. No part of the structure will be moved closer to the water, and the lower floor elevations will remain the same. The existing grade will be maintained with its lowest point at 2.29 m in the northwest corner.



Figure 2-1: Site Location Plan. Image from CRD Regional Map (1:50,000)



Figure 2-2: View of Local Coastline at 405 Treebank Road East. Image from CRD Regional Map

3.0 APPLICABLE REGULATIONS

We understand that the Town of Esquimalt has requested a Flood Hazard Assessment by a qualified Professional Engineer with specific consideration for tsunami hazard. The province of BC has not adopted flood risk tolerance criteria. Several guidelines around flood risk have been established, giving local governments the authority to develop flood hazard bylaws. This assessment has been conducted following the *Provincial Flood Hazard Area Land Use Management Guidelines* and the *Engineers and Geoscientists of BC Legislated Flood Assessments in A Changing Climate In BC*. A thorough review of relevant provincial and regional resources were also reviewed for this purpose. The following is a list of the referenced and applicable documents:

1. AECOM. (2013). *Capital Regional District - Modelling of Potential Tsunami Inundation Limits and Run-Up*. Victoria.
2. AECOM. (2015). *Coastal Sea Level Rise Risk Assessment*. Capital Regional District.
3. BC Ministry of Environment. (2011c). *Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use - Sea Dike Guidelines*. Ausenco Sandwell.
4. Capital Regional District. (2021). *Task 2 - Sea Level Rise Modelling Mapping Report, Capital Region*. Victoria: CRD.
5. Capital Regional District. (2021). *Task 3 - Tsunami Modelling and Mapping Report, Capital Region Coastal Flood Inundation Mapping Project*. Victoria.
6. EGBC. (2018). *Professional Practice Guidelines - Legislated Flood Assessments in a Changing Climate in BC*.
7. Natural Resources Canada. (Federal Flood Damage Estimation Guidelines for Buildings and Infrastructure). 2021. Government of Canada.
8. Paragon Engineering Limited. (1985). *Development of Flood Depth-Damage Curves for Residential*. Ottawa: Environment Canada, Ontario Ministry of Natural Resources.
9. Province of British Columbia. (2018). *Flood Hazard Area Land Use Management (FHALUM) Guidelines - Section 3.5 & 3.6*. BC Ministry of Water, Land and Air Protection.

4.0 COASTAL FLOOD HAZARD ASSESSMENT

Coastal flood hazards are primarily dictated by flood inundation, but can include overflow and spray, shoreline erosion and scour, beach degradation and aggradation, or physical loading from hydraulic forces or wood debris. To reduce the likelihood of damage from coastal flood inundation, the coastal flood level was assessed and used to derive a minimum construction level – the flood construction level (FCL). The FCL provides a mitigation measure to limit the likelihood of flooding for developments located along or near the coast. The minimum provincial standard is to assess flood levels based on events having an annual exceedance probability (AEP) of 0.5% (1-in-200 year event), although local governments may decide to adopt more stringent criteria. In addition, due to global climate change and related sea-level rise, future conditions are considered up to the expected life of the structure; often up to the year 2100 (78 years from present).

4.1 Flood Level

The Flood Construction Level (FCL) can typically be determined by applying the “Combined Method” outlined in *Guidelines for Management of Coastal Flood Hazard Land Use* (BC Ministry of Environment, 2011c). The FCL Combined Method is used to establish a flood construction level which will protect life and property of the occupants of a structure. By the Combined method, the FCL shall be determined as the sum of:

- Higher high water large tide (HHWLT);
- Allowance for future Sea Level Rise (SLR) to the year 2100;
- Allowance for regional uplift, or subsidence to the year 2100;
- Estimated storm surge for the Designated Storm with an AEP of 1:500;
- Estimated wave effects associated with the Designated Storm; and
- A minimum freeboard of 0.3 m.

These components are illustrated in Figure 4-1.

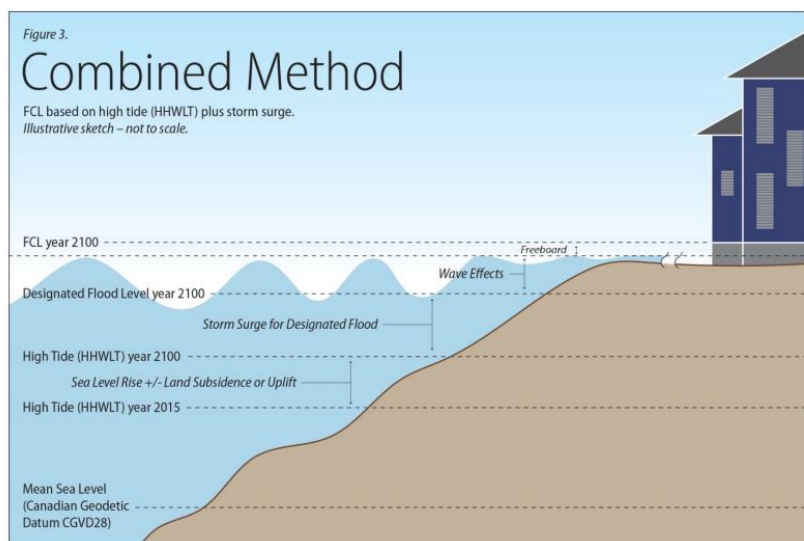


Figure 4-1: Combined Method

By this methodology, the FCL was calculated to be 4.66 m geodetic for the subject site. However, the recent *Sea Level Rise Modelling Mapping Report* (Capital Regional District, 2021) provides a more detailed analysis using local transects (cross sections) through the specific shoreline locations (transects) to estimate discrete wave action and flood conditions. This recent modelling is considered more detailed and site specific than the combined method, therefore we have used this information in our assessment.

Table 4-1: Summary of Values for FCL Calculation

FCL Component	Elevation (m CGVD 2013)
Highest High Water Large Tide in Victoria Harbour	1.37
Foreshore FCL at Transect TR_068	3.63
Backshore FCL at Transect TR_068	3.63

The property backs on to the Gorge Waters and the bank has been reinforced with stacked repurposed concrete. The rear yard area is relatively flat, and the elevation is 3.34 meters with a moderate descent at the foreshore. Given this topography, the property is located within the “foreshore” area, within the primary wave effect zone. Based on the above, the applicable Flood Construction Level for the subject site is **3.63 m CGVD 2013**.

Figure 4-2 and Figure 4-3 below show the flood construction level for transect TR_068 and the inundation mapping for the 0.5% AEP event with 1.0 m of relative sea level rise (RSLR).

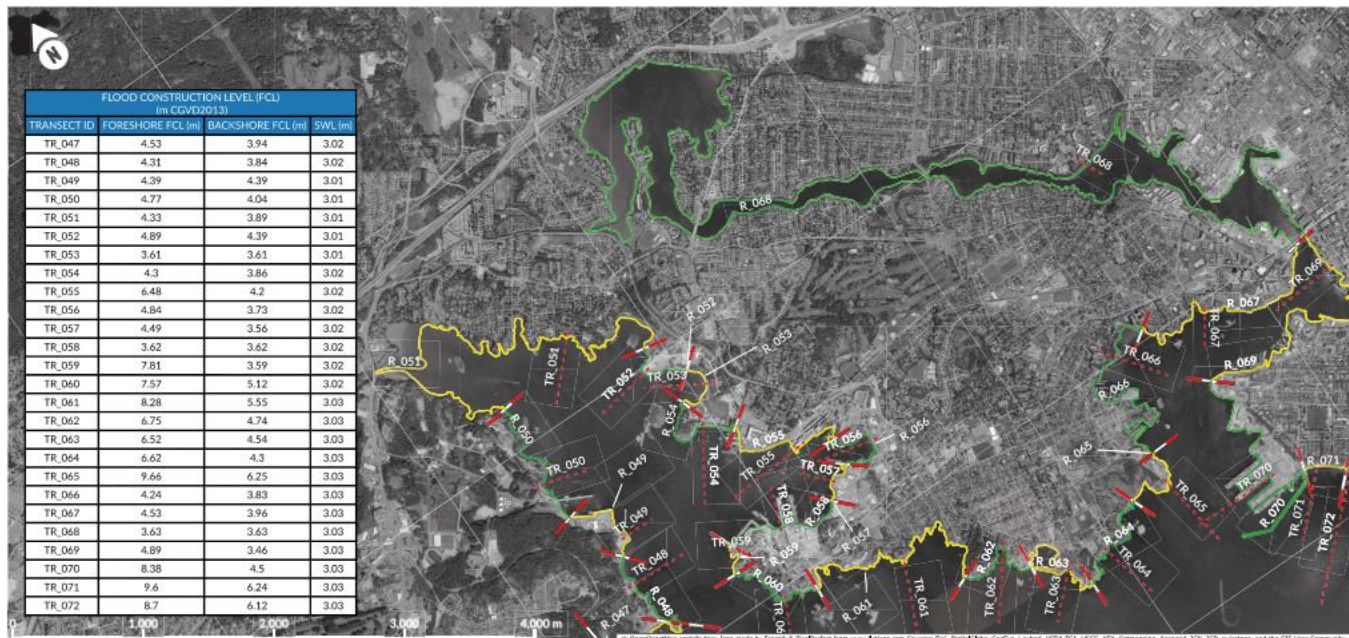


Figure 4-2: Flood Construction Level for 1.0m RSLR (405 Treebank Road East at TR_068)



Figure 4-3: Inundation Mapping for 0.5% AEP + 1.0m RSLR for Victoria Harbour

4.2 Consideration of Tsunami Impacts

In addition to wave and storm events, high water levels and inundation of coastal property could potentially occur from a tsunami event. The Victoria area is at risk of tsunami events due to local crustal earthquakes and the Cascadia Subduction Zone (CSZ) earthquakes. The tsunami events initiated by these earthquakes have been researched locally to the extent that flooding elevations have been calculated and probabilities of occurrence are available. We have completed this aspect of the assessment with reference to BC Flood Hazard Land Use Guidelines (BC Ministry of Environment, 2011c). The document provides the following guidance on the required assessment:

"At a minimum, building conditions should protect improvements from damage from a tsunami of equal magnitude to the March 28, 1964 tsunami that resulted from the Prince William Sound, Alaska earthquake and a possible Cascadia Subduction Zone earthquake."

In completing this assessment, no new modelling or probabilistic analysis has been completed. We have relied on the *Tsunami Modelling and Mapping Report* completed for the Capital Regional District (Capital Regional District, 2021). The *Tsunami Modelling and Mapping Report* recommends using Cascadia Subduction Zone Northern Segment (CSZ-NS) as the standard, where tsunami risk exceeds the corresponding 1.0 m RSLR flood construction level (FCL) at the specific location.

Table 4-2 presents a comparison of the coastal flood construction levels to the tsunami water surface elevation for the CSZ-NS event.

Table 4-2: Summary of FCL vs. Tsunami Inundation for CSZ-NS event

Item:	Elevation (m CGVD 2013)
Tsunami Water Surface Elevation from CSZ-NS for TR_068*	4.60
Foreshore FCL at Transect TR_068 (Site Specific)	3.63
Backshore FCL at Transect TR_068 (Site Specific)	3.63

*From Appendix D of *Tsunami Modelling and Mapping Report*

Because the CSZ-NS water surface elevation exceeds the foreshore and backshore flood construction level, it will govern for the subject property, and the FCL should be taken as the CSZ-NS water surface elevation, or **4.60 m CGVD 2013**.

It should be noted, that the much larger CSZ-L1 event would result in tsunami wave heights and subsequent run-up which exceeds the CSZ-NS event. However, the return period for this event, approximately 2,500-year is far in excess of the 200-year, or 500-year sea level rise flooding design event typically applied to regular developments such as private dwellings, local businesses, municipal facilities, etc. (BC Ministry of Environment, 2011c). According to the *Tsunami Modelling and Mapping Report Table ES-3*, the approximate arrival time of this CSZ-L1 Tsunami event is predicted to be 75 minutes. Travel times denote the amount of time in minutes required for the first tsunami wave to travel to a particular location, after generation at the source (Capital Regional District, 2021). This is expected to provide sufficient time for the safe egress of the dwelling structures, both existing and proposed, for the subject property.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The flood construction level for the subject property is **FCL is 4.60 m CGVD 2013**. This level would be applicable to new construction. However, flood hazard guidelines include provisions for existing buildings and additions based on proposed floor area increase. The following applicable provisions are summarized in Table 5-1 below:

Table 5-1: Applicable Provisions for Additions & Renovations in Flood Hazard Guidelines

Guideline:	Provision for Renovations / Additions:
(BC Ministry of Environment, 2011)	<i>"Renovations to existing buildings within the existing footprint of the building are not affected by these guidelines. Additions of up to 25% of the floor area, at the elevation of the existing building can be allowed, provided that the addition is no closer to the existing natural boundary than the existing building".</i>
(EGBC, 2018)	<p><i>"Where a renovation or expansion would result in the total floor space being increased by no more than 25% of the floor space existing at the time of the original building construction, it is considered appropriate professional practice to implement the following measures when making submissions for renovation or expansion building permit applications:</i></p> <ul style="list-style-type: none">■ <i>Where the building is subject to a Flood Hazard, the <u>new floor area</u> should be at or above the existing floor elevation.</i>■ <i>The method of achieving the required floor elevation (fill, structural, or any combination) may be the same as for the existing building.</i>■ <i>Where the building site is subject to a possible erosion hazard, any expansion must not intrude into the setback zone farther than the existing building.</i>■ <i>Any extension of the building foundation should consider hydraulic loading and scour.</i>■ <i>Construction of additional or new erosion protection works may be required (such works must be suitably robust in view of the purpose of protecting a house), subject to environmental agency approval and with documentation of future operation and maintenance requirements for the owner."</i>

Based on the preceding, the following presents our conclusions for the proposed development:

1. The *Plans* propose to retain the existing basement floor elevation of 2.29 m. Since this basement floor space is existing and not proposed to increase, its use is not limited by the referenced guidelines. However, this floor space is below both the FCL and tsunami inundation level, therefore hazard exists for this lower floor space.
2. For the main level, the *Plans* propose to build within the existing footprint; a small ground floor area will be removed and replaced with a main floor addition in the kitchen area, resulting in an overall reduction of the structure's footprint. The addition will be no closer to the existing natural boundary. Therefore, it is our opinion that the land is safe for the use intended, i.e. a renovation of the structure within the existing footprint.
3. As noted above the development is acceptable as proposed, however, it may be prudent consider methods to increase the flood resiliency of the development. The installation of furnaces, major electrical switchgear, or other fixed equipment susceptible to damage by floodwater should be avoided

below the FCL. It is common to place main electrical and mechanical infrastructure above the FCL, and any electrical supply below the FCL (i.e. outlets or lighting) should be protected by GFCI (ground fault circuit interruption) located above the FCL, or other approach approved by an electrical engineer to be safe for use below the FCL.

4. The flood depths are not expected to destabilize structure's foundations (Paragon Engineering Limited, 1985). We expect that the ground conditions are suitable resistance to erosion during short term flood events, therefore, conventional reinforced strip and spread footings are considered suitable founded at typical depths of 0.45 m or more below existing grade.
5. Erosion of the foreshore area was not observed during our site review. However, the bank is overgrown with invasive English ivy, and if invasive species are proposed to be removed the reinstatement of any disturbed bank should consider erosion protection and bank stability. We recommend a geotechnical engineer be retained to assess following removal and prescribe appropriate erosion mitigation or reinstatement works.
6. The effects of a design flood event would be significant, specifically the tsunami events, and it should be noted that, as with earthquake and fire hazards, it is generally accepted that new buildings will sustain significant damage and may not be habitable. The standard is that the building must remain safe for egress to protect against loss of life and human trauma. Due to the rate of sea level rise, the likelihood of loss of life or limb due to flooding caused by sea level rise is extremely low. We expect that occupants will have time to safely evacuate, remove property, or prepare floodproofing measures. Economic losses should be expected during the design flood event, but this will occur regardless of whether development proceeds at the subject site.

Based on this assessment, it is our opinion that the land is safe for the use intended, i.e. a renovation of the structure within the existing footprint. As a condition of the Building Permit, a Section 219 covenant should be registered on the title of the property with this Flood Hazard Assessment attached. The covenant shall notify future owners of the property of the susceptibility to flooding and hold the Township of Esquimalt harmless from future claims and damages.

6.0 CLOSURE

Coast Geotechnical has completed this geotechnical report based on the information provided by the client, our site review, and our understanding of the project as described herein. This report has been prepared solely for the use of the client, their design team and contractors, and Coast Geotechnical accepts no responsibility for any other use of this report.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or require clarification of the above, please do not hesitate to call.

For:

Coast Geotechnical

Prepared by:



Alyse Munro Hindley
Geotechnical EIT

Reviewed by:

Ben Schmidt, P. Eng
Principal | Senior Geotechnical Engineer

ATTACHMENTS:

Flood Assurance Statement

FLOOD ASSURANCE STATEMENT

Note: This statement is to be read and completed in conjunction with the current Engineers and Geoscientists BC *Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC* ("the guidelines") and is to be provided for flood assessments for the purposes of the *Land Title Act*, Community Charter, or the *Local Government Act*. Defined terms are capitalized; see the Defined Terms section of the guidelines for definitions.

To: The Approving Authority
Township of Esquimalt

Date: May 1, 2023

1229 Esquimalt Road, Esquimalt, BC V9A 3P1

Jurisdiction and address

With reference to (CHECK ONE):

- ☐ *Land Title Act* (Section 86) – Subdivision Approval
- ☐ *Local Government Act* (Part 14, Division 7) – Development Permit
- ☒ Community Charter (Section 56) – Building Permit
- ☐ *Local Government Act* (Section 524) – Flood Plain Bylaw Variance
- ☐ *Local Government Act* (Section 524) – Flood Plain Bylaw Exemption

For the following property ("the Property"): LOT 6, SECTION 2, ESQUIMALT DISTRICT, PLAN 7338
405 TREEBANK ROAD EAST, ESQUIMALT, BC, V9A 4H5

Legal description and civic address of the Property

The undersigned hereby gives assurance that he/she is a Qualified Professional and is a Professional Engineer or Professional Geoscientist who fulfils the education, training, and experience requirements as outlined in the guidelines.

I have signed, sealed, and dated, and thereby certified, the attached Flood Assessment Report on the Property in accordance with the guidelines. That report and this statement must be read in conjunction with each other. In preparing that Flood Assessment Report I have:

[CHECK TO THE LEFT OF APPLICABLE ITEMS]

___ 1. Consulted with representatives of the following government organizations:

- ☒ 2. Collected and reviewed appropriate background information
- ☒ 3. Reviewed the Proposed Development on the Property
- ☒ 4. Investigated the presence of Covenants on the Property, and reported any relevant information
- ☒ 5. Conducted field work on and, if required, beyond the Property
- ☒ 6. Reported on the results of the field work on and, if required, beyond the Property
- ☒ 7. Considered any changed conditions on and, if required, beyond the Property

8. For a Flood Hazard analysis I have:

- ☒ 8.1 Reviewed and characterized, if appropriate, Flood Hazard that may affect the Property
- ☒ 8.2 Estimated the Flood Hazard on the Property
- ☒ 8.3 Considered (if appropriate) the effects of climate change and land use change
- ☒ 8.4 Relied on a previous Flood Hazard Assessment (FHA) by others
- ☒ 8.5 Identified any potential hazards that are not addressed by the Flood Assessment Report

9. For a Flood Risk analysis I have:

- ___ 9.1 Estimated the Flood Risk on the Property
- ___ 9.2 Identified existing and anticipated future Elements at Risk on and, if required, beyond the Property
- ___ 9.3 Estimated the Consequences to those Elements at Risk

FLOOD ASSURANCE STATEMENT

10. In order to mitigate the estimated Flood Hazard for the Property, the following approach is taken:

- ☒ 10.1 A standard-based approach
- ☐ 10.2 A Risk-based approach
- ☒ 10.3 The approach outlined in the guidelines, Appendix F: Flood Assessment Considerations for Development Approvals
- ☒ 10.4 No mitigation is required because the completed flood assessment determined that the site is not subject to a Flood Hazard

11. Where the Approving Authority has adopted a specific level of Flood Hazard or Flood Risk tolerance, I have:

- ☐ 11.1 Made a finding on the level of Flood Hazard or Flood Risk on the Property
- ☐ 11.2 Compared the level of Flood Hazard or Flood Risk tolerance adopted by the Approving Authority with my findings
- ☐ 11.3 Made recommendations to reduce the Flood Hazard or Flood Risk on the Property

12. Where the Approving Authority has not adopted a level of Flood Hazard or Flood Risk tolerance, I have:

- ☒ 12.1 Described the method of Flood Hazard analysis or Flood Risk analysis used
- ☒ 12.2 Referred to an appropriate and identified provincial or national guideline for level of Flood Hazard or Flood Risk
- ☒ 12.3 Made a finding on the level of Flood Hazard or Flood Risk tolerance on the Property
- ☒ 12.4 Compared the guidelines with the findings of my flood assessment
- ☒ 12.5 Made recommendations to reduce the Flood Hazard or Flood Risk

☒ 13. Considered the potential for transfer of Flood Risk and the potential impacts to adjacent properties

☐ 14. Reported on the requirements for implementation of the mitigation recommendations, including the need for subsequent professional certifications and future inspections.

Based on my comparison between:

[CHECK ONE]

- ☐ The findings from the flood assessment and the adopted level of Flood Hazard or Flood Risk tolerance (item 11.2 above)
- ☒ The findings from the flood assessment and the appropriate and identified provincial or national guideline for level of Flood Hazard or Flood Risk tolerance (item 12.4 above)

I hereby give my assurance that, based on the conditions contained in the attached Flood Assessment Report:

[CHECK ONE]

- ☐ For subdivision approval, as required by the *Land Title Act* (Section 86), "that the land may be used safely for the use intended":
[CHECK ONE]
 - ☐ With one or more recommended registered Covenants.
 - ☐ Without any registered Covenant.
- ☐ For a development permit, as required by the *Local Government Act* (Part 14, Division 7), my Flood Assessment Report will "assist the local government in determining what conditions or requirements it will impose under subsection (2) of this section [Section 491 (4)]".
- ☒ For a building permit, as required by the *Community Charter* (Section 56), "the land may be used safely for the use intended":
[CHECK ONE]
 - ☒ With one or more recommended registered Covenants.
 - ☐ Without any registered Covenant.
- ☐ For flood plain bylaw variance, as required by the *Flood Hazard Area Land Use Management Guidelines* and the *Amendment Section 3.5 and 3.6* associated with the *Local Government Act* (Section 524), "the development may occur safely".
- ☐ For flood plain bylaw exemption, as required by the *Local Government Act* (Section 524), "the land may be used safely for the use intended".

FLOOD ASSURANCE STATEMENT

I certify that I am a Qualified Professional as defined below.

May 1, 2023

Date

Coast Geotechnical

Prepared by

Ben Schmidt, P.Eng.

Name (print)



Signature

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Telephone

ben@coastgeotechnical.ca

Email

Coast Geotechnical

Reviewed by

Alyse Munro-Hindley, EIT

Name (print)



Signature

(Affix PROFESSIONAL SEAL here)

If the Qualified Professional is a member of a firm, complete the following:

I am a member of the firm Coast Geotechnical - Permit to Practice # 1001639
and I sign this letter on behalf of the firm. (Name of firm)